Natural Sciences;	Inorganic Nature;	Organic Nature.
Descriptive. General Physiography, or Natural History.	Mineral Physiography. Descriptive and Systematic Mineralogy; Geognosy; Geography; Descriptive Astronomy.	Biophysiography. Organography; Descriptive and Systematic Botany and Zoölogy.
Philosophical. General Physiology, or Natural Philosophy.	Mineral Physiology. *Dynamics* or *Physics; Chemistry.* Geogeny; Theoretical Astronomy.	Biophysiology. *Biotics.* Organogeny; Morphology; Physiological Botany and Zoölogy.

PROCEEDINGS OF SECTION A. — MATHEMATICS AND ASTRONOMY.

PAPERS READ BEFORE SECTION A.

[*Continued.*]

Orbit of the great comet of 1882.

BY EDGAR FRISBIE OF WASHINGTON, D.C.

THIS is a partial record of observations at Washington. Mr. Winlock is preparing a description of all the physical phenomena of the comet which were there observed. The first Washington observation of the comet was at two o'clock on a September afternoon, and a comparison was then made with the position of the sun. Good observations were obtained on the meridian for three days. The calculations from these served to fix the place of the comet with fair approximate accuracy for three months, which was a somewhat remarkable success. Afterward a difficulty occurred in obtaining accurate observations; because there were several different points of light presented in an ill-defined nucleus, and it was uncertain whether the observations always referred to the same luminous point. These observations were made in October and November. The following ephemeris was calculated: —

Sept.	17.2282	ϕ	89° 13′ 42.70″
Ω	346° 1′ 7.91″	log. a	1.9331366
$\pi\ \Omega$	69 36 12.79	log. q	7.8904739
i	141 59 52.16	period	793.689

The author compared the foregoing with the observations of other astronomers. The most prominent variation was in respect to the period, which others gave as 659, 997, 852, and 654 years. A contrivance was exhibited, showing the respective positions of the earth and comet, and their directions of motion, by means of pasteboard planes attached at an angle.

The rotation of domes.

BY G. W. HOUGH OF CHICAGO, ILL.

OBSERVATORY domes are in general very heavy. As they grow old, owing to the settling of walls and other changes, they are apt to become almost unmanageable. The dome at Chicago is very weighty, every thing about the observatory being built in a very substantial manner. When Dr. Hough first tried to move the dome, he found its two sides working with unequal friction; and this was afterward remedied to some extent, but by no means fully. About two months ago a gas-engine was placed in position to revolve the dome. It was a great satisfaction to see the dome go round continuously, without hitches. The cost of moving the dome by such means is a mere trifle, aside from the first cost of the engine. The use of water-power where that was easily accessible must, however, be preferred in many instances where a sufficient head is supplied by street mains.

Dr. C. A. Young said, in discussing the foregoing, that when he came to Princeton he found a very heavy dome there. One man, using thirty pounds pressure on a two-foot crank, was very tired after giving the dome one turn. A gas-engine has since been put in below, and the power is communicated by a belt. A revolution can be made in four minutes, and the shutter raised in two. In general, the dome is placed and the shutter opened within five minutes. Dr. Young expressed a hope that the Brush storage batteries would furnish electrical illumination and power for the work of observatories, as the electricity might be stored even from a gas-engine operating a dynamo during hours of the day when there was no other use for its power. At present the direct action of a gas-engine on a dynamo, with no intervention between the dynamo and the light, was too irregular to serve the purpose.

Descriptive-geometrical treatment of surfaces of the second degree.

BY J. BURKITT WEBB OF ITHACA, N.Y.

FOR the purpose of greater conciseness the speaker confined his remarks to the general ellipsoid, remarking that the usual treatment of problems upon this surface — as, for instance, such problems as finding the shade and shadow, or drawing tangent planes — is lacking in generality; the body being taken in such

special position, or referred to such special axes, as reduce the general problem to a specially simple one.

The speaker then drew the projections of three conjugate diameters of a general ellipsoid upon the board, stating that this was the best method of defining that body. He then proceeded to find the projections of the enveloping cylinders, and the shadow of the body; which he showed could as easily be done for the general ellipsoid, in a perfectly general position, as for special cases. In fact, it appeared that problems on this body gained nothing in simplicity by special methods and devices which detract from the generality of the treatment.

List of other papers.

The following additional papers were read in this section, some of them by title only: Tidal observations on soundings distant from shore, by *J. M. Batchelder.* Investigation of light variations of Sawyer's variable, by *S. C. Chandler.* Standard time-pointer and a time longitude dial; System of algebraic geometry, by *Samuel Emerson.* The calculus of direction and position, by *E. W. Hyde.* Observations on the transit of Venus made at Columbia college; Description of the new observatory at Columbia college, by *J. K. Rees.* The light variations of T. Monocerotis, by *E. F. Sawyer.* Method of observing eclipses of Jupiter's satellites, by *D. P. Todd.* Conic sections in descriptive geometry, by *J. B. Webb.* Descriptive geometry applied to the general ellipsoid, by *C. M. Woodward.* Some observations on Uranus, by *C. A. Young.*

PROCEEDINGS OF SECTION B. — PHYSICS.

PAPERS READ BEFORE SECTION B.

[*Continued.*]

The tornado at Racine, May 18, 1883.

BY P. R. HOY OF RACINE, WIS.

A CURIOUS mistake preceded the reading of this paper. There was some confusion between the abstracts of this and another paper on a tornado, which were submitted to the sectional committee; and the other paper was entered on the daily programme, but was withdrawn.

Mr. Hoy's paper began by stating that the early part of the day was pleasant, but about 6.45 in the evening two clouds of ominous appearance joined, from opposite quarters of the heavens, and at once the cyclone began. Its general direction was to the north of east. There was no rain at Racine with the storm, but there was noticed a very strong odor of ozone while the cyclone was at its height. At the start it was barely two rods wide, but when it reached Racine it had expanded to twenty rods. Its motion was rotary and oscillatory, and all *débris* was thrown to the centre of the track. When the cyclone crossed the lake it formed huge waterspouts, one central, and seven to eight accessory, whirling about the main trunk.

Prof. H. A. Rowland proceeded to discuss the paper as follows: Most observers of tornadoes just perceive that there is a whirling motion of the air, and it knocks down objects, and that is the principal thing they see. But that is very ordinary observation. Of course, a column of air in such swift rotation will tear houses down, spurt water up, and do every thing of that sort. The particular point which I observed in this paper was the description of the formation of the tornado. The phenomenon which is to be explained is the formation of the tornado, and very few have observed this. This description was very short; merely, that, over in the west or south-west, the clouds formed. Of course, to an observer from the west, one would appear north, and the other south. The point I wish to bring out is, that there was lightning passing between the two clouds. In Mr. Finley's description of six hundred tornadoes, I do not see any similar account. Many observers have seen lightning play around these clouds, but not passing between the two clouds. Mr. Finley applied to me to know whether there was any thing in the electrical theory of a tornado. Of course, any theory of the destruction being caused by electricity, houses being attracted, etc., — all that is mere nonsense. We know that the attraction of electricity is only a mere fraction of an ounce to the square inch. Before the force becomes sufficient to raise a great weight, a spark passes, and a discharge of electricity takes place. But in this case (these two clouds passing from north to south, and boiling up, having flashes of lightning playing round them), I thought there might be something in the electrical theory, as far as formation was concerned; and I calculated for the signal-service and Mr. Finley what amount of energy there was in two clouds approaching each other in this way. The rotation of the earth will cause them to come together, not in a straight line, but a little aside from each other, forming a spiral motion. The direction of the rotation of the tornado is a necessary consequence of the earth's rotation: so that it might be possible to have these electrified clouds approach each other by mutual attraction, and form a tornado at the point where they meet. I calculated the energy, and found there was sufficient for a rather small tornado in the case I took. I would not be willing to say that is the theory of all tornadoes. I say that it is only possible. There is a great deal more energy in a mass of air heated up to a considerable temperature, and rising, by force of gravitation, — a great many times more. If it were not for the electrical phenomena observed in the case, I should say there was very little probability of the electrical theory. I believe Mr. Finley will direct the signal-service observers to watch the direction of the wind. If it flows in from all directions at the point where the tornado is formed, we should determine it to be due to the rise of hot air at that point. When the ground is very hot and the